Assessment of Monitored Natural Recovery Using Multiple Lines of Evidence
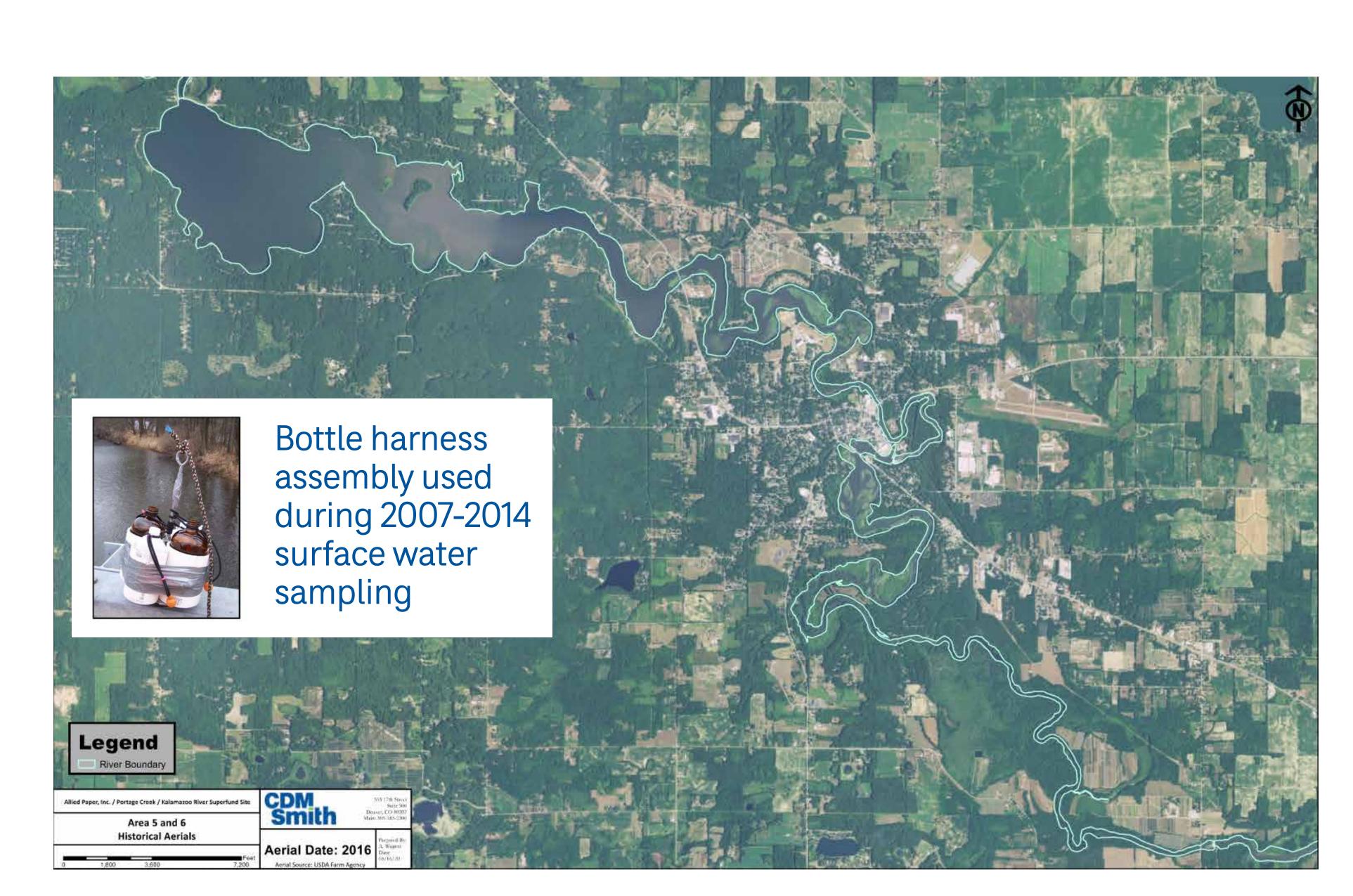
Wardah Azhar, PhD, PE (CDM Smith)
Rooni Mathew (CDM Smith)
Keegan Roberts (CDM Smith)
Daniel Peabody (Michigan Department of Environment, Great Lakes, and Energy)
Sydney Ruhala (Michigan Department of Environment, Great Lakes, and Energy)

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

Poster Group 2

INTRODUCTION

▶ Operable Unit 5 (OU5) of the Allied Paper Inc./ Portage Creek/ Kalamazoo River Superfund Site (Site):

- Includes about 80 miles of the Kalamazoo River and associated floodplains
- Runs from Morrow Lake Dam to Lake Michigan with a 3-mile stretch of Portage Creek from Alcott Street to its confluence with the Kalamazoo River

▶ Michigan Department of Environment, Great Lakes and Energy (EGLE) and CDM Smith, Inc. (CDM Smith) will investigate if using monitored natural recovery (MNR) as a component of a potential remedy for Areas 5 and 6 of OU5 is feasible

▶ Project will consider multiple lines of evidence (LOEs) to determine applicability of MNR as a remedy for all or part of Areas 5 and 6

▶ Upstream sources deposited polychlorinated biphenyls (PCBs) downstream of Trowbridge Dam and in Lake Allegan in the Areas

Bottle harness assembly used during 2007-2014 surface water sampling

Areas 5 and 6 in 2016

APPROACH

▶ Long-term monitoring data collected in different media—sediment, surface water, biota—since the 1990s

▶ Field investigations conducted over different time periods will supplement historical long-term monitoring data and evaluate current conditions

▶ Team will develop a plan with sampling requirements to evaluate the efficacy of MNR in Areas 5 and 6 based on the following:

- Existing chemical and physical characterization of soil, sediment, surface water, and biota
- Multiple LOEs:

  - Sediment erosion/ deposition rates
  - Sediment layer thicknesses
  - PCB concentrations in bulk sediment
  - PCB concentrations in surface water and porewater
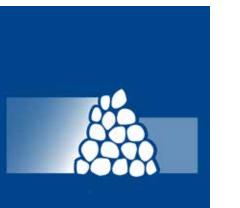 - Fish tissue concentrations

- Identified data gaps

▶ Team to use resulting datasets to assess spatial and temporal trends within the various media, informing natural recovery potential

▶ Team will use statistical comparison and regression analysis methods to evaluate trends and estimate rates of recovery following the general procedures described in Gibbons and Coleman (2001)

- Potential influence of below detection limit results (non-detect data) will likely require censored data statistical method, detailed in Helsel (2012)
- Method includes Kaplan-Meier (KM) survival analysis, paired Prentice-Wilcoxon (PPW) tests, and nonparametric Akritas-Theil-Sen (ATS) regression analysis

▶ Methods will be implemented in the program R (R Development Core Team 2019); team may also use conceptual and numerical modeling evaluations of contaminant fate and transport processes and sediment stability

PROPOSED MNR DATA COLLECTION

Sediment Coring – Team will collect sediment cores using Vibracore, geoprobe, sonic drill, or similar sampling equipment. Cores will be analyzed for chemical and physical characteristics, geochronology, and shear strength (via SEDflume analysis).

Sediment Traps – Team will deploy sediment traps to collect and then characterize suspended sediments in the water column.

Physical Particle Tracking – Team will release a known quantity of manufactured particles with fluorescent and/or magnetic properties, then sample for the particles in downstream locations.

Surface Water Sampling – Team will test surface water conditions, a crucial component in evaluating the effectiveness of MNR. Samples collected over different time periods will help assess temporal trends in surface water conditions.

Fish Tissue Concentrations – Team will collect smallmouth bass and carp tissue samples, consistent with USEPA 2014, which recommends using higher-trophic-level biota (fish) to evaluate long-term trends of contamination in biota tissue.

Porewater Concentrations – Team will test porewater concentrations, which provide a more direct indication of bioavailability to benthic organisms (Magar 2009) relative to bulk sediment concentrations.

Bathymetric Surveys – Team will use differential bathymetry (in conjunction with other LOE) to determine net sedimentation rates. Evaluating changes in bathymetry over different time periods provides an understanding of localized deposition and erosion, which can be used to identify areas where ongoing natural recovery is more apparent.

Aerial view looking northeast at the Trowbridge Impoundment

Carp in about 1 foot of water within the Trowbridge Inundation Study Area (middle of photo)

REFERENCES

Gibbons, R.D. and D.E. Coleman, 2001. Statistical Methods for Detection and Quantification of Environmental Contamination. Wiley, 384 pp.

Helsel, D.R, 2012. Statistics for Censored Environmental Data Using Minitab and R. Second Edition, Wiley, 324 pp.

Magar V.S., et al., 2009. Technical Guide: Monitored Natural Recovery at Contaminated Sediment Sites. ESTCP Project ER-0622. May.

U.S. Environmental Protection Agency (USEPA), 2014. Technical Resource Document on Monitored Natural Recovery. April. https://semspub.epa.gov/work/HQ/174390.pdf.

For more information, please contact:

Wardah Azhar, PhD, PE
AzharW@cdmsmith.com